strated[7] eight years ago that several sugars result thus, among them a fermentable one, called by me methose and declared later to be inactive laevulose by Fischer. If we now express our view on the formation of albuminous matter in plant cells, especially in the microbes, by equations, we obtain:

$$\text{I.}\quad \underbrace{4CH_2O}_{\text{formic aldehyde}} + NH_3 = \underbrace{C_4H_7NO_2}_{\text{asparaginic aldehyde}} + 2H_2O$$

$$\text{II.}\quad 3C_4H_7NO_2 = C_{12}H_{17}N_3O_4 + 2H_2O$$

$$\text{III.}\quad 6C_{12}H_{17}N_3O_4 + 12H + H_2S = \underbrace{C_{72}H_{112}N_{18}SO_{22}}_{\text{simplest expression for albumen}} + 2H_2O.$$

This theory would doubtless indicate the simplest way possible for the formation of proteids; it is true, that some objections could be raised especially in regard to equation I., but we will at a future occasion explain what principal conclusions drawn from this hypothesis were confirmed by experiments.

INTRODUCTORY ADDRESS TO A COURSE OF LECTURES ON VULCANOLOGY IN THE R. UNIV. OF NAPLES.

BY H. J. JOHNSTON-LAVIS, M.D., M.R.C.S., F.G.S., ETC., NAPLES, ITALY.

VULCANOLOGY, or the science which concerns volcanoes and their phenomena, is a very important branch of geology, or the science which treats of the earth's crust in general. Geology is yet hardly a century old, because before that time it consisted of little else than a collection of romantic hypotheses and incredible superstitions. This remark applies with still greater force to vulcanology, for the study of which it is most necessary to possess an extensive knowledge of physics and chemistry, besides a highly developed faculty of observation. Notwithstanding, for a century or two previous to the nineteenth there were acute observers, and we in Naples well know such names as those of Sorrentino, Duca e Padre della Torre.

Towards the end of the last century the active and extinct volcanic regions of Italy attracted the attention of four great scientists, each of a different nationality: these four illustrious men were Spallanzani, Sir William Hamilton, Dolomien and Breislak. Although their nationality was different, they had two merits in common—that of scientific truth and that of Baconian methods of reasoning. In other words, they were pure scientists, since by that term we understand one who observes carefully, records neither more nor less than he observes and draws from these facts and those collected by others his conclusions without disregard to a clear knowledge of the principles involved, and without imagining facts that never existed which give rise to the enunciation of romantic hypotheses and scientific castles in the air. It is therefore more to these four men that we owe the advance of human knowledge concerning volcanoes than to all the writers who preceded them.

In the first years of the nineteenth century, vulcanological literature was enriched by many scientists, because as the allied sciences were then making great strides, they were able to offer to vulcanologists much more powerful and accurate means of investigation. Thus we had Humboldt, Scrope, Daubeny, Pilla and Gemmellaro.

Following these came a phalanx of illustrious students of that branch of geology, some still amongst us, others unfortunately dead in person but living and immortal in the memory of man as heroes of science and of human knowledge. Amongst these we may enumerate Lyell, Dana, Scacchi, Palmieri, Silvestri and Phillips, whilst at present many younger and gifted investigators are not wanting.

No other branch of science has been so heavily burdened by extravagant hypotheses which have so much retarded its progress as that of vulcanology. It is not only in the first half of the present century that we find an extensive literature, the production of men who advertised themselves as scientists when in truth they did little else but write memoirs and books to promulgate and sustain fantastic, extravagant, imaginary and impossible hypotheses. Even to-day only those who like myself have had the misfortune to be obliged to review the vulcanological literature can appreciate the large quantity of rubbish which is yearly published in the name of science. Nevertheless, amongst so much of this chaff we do meet with grain, but also very good grain.

As a subject of study, Vesuvius holds the first place in all vulcanological investigations of this and the last century. A few figures will make this fact more evident. Some four years since my wife and myself collected the titles of books, memoirs, and other writings referring to the south Italian volcanoes for the purpose of publishing a bibliographical list. We found the following numbers:

Graham's Island or Isola Ferdinandea	28
Roccamonfina	33
Lipari Islands	119
Alban Hills	210
Campi Phlegræi	539
Etna	880
Vesuvius	1552

From this table we comprehend how much has been written concerning our great active volcano, which we find constitutes nearly half of what has been written about all the volcanic regions south of Rome. If we add to these the titles referring to the Campi Phlegræi we then find that in a total of 3361 not less than 2091 concern the volcanic district around Naples. Let me, however, give you a still more striking fact. The Naples branch of the St. Alpine Club possesses the richest vulcanological library in existence. The catalogue contains more than 7000 entries of papers, books and manuscripts. However, in this number are included books that not only treat of vulcanology but in a large part refer to seismology and to a smaller extent to geology. It will be seen, therefore, that the Neapolitan volcanic district represents more than a quarter of all vulcanological literature.

It is true that the history of Etna and the Æolian Islands reaches farther back than that of Vesuvius, but on the other hand the history of this latter is by far the most complete. From a chronological point of view Vesuvius and also the Campi Phlegræi have a more important place in history than any of their rivals. Even if the Pompeiians, the Herculaneans and the Stabians did lose all their property eighteen centuries since, the modern world has recovered it as achæological treasures whose value represents, from the point of view of culture, many times the original one, and the compound interest on the same for the whole interval; and this we owe to our Vesuvius. The phlegrean region around Naples is so enchained with the poetry of the heroic and classic periods, that without it the legends of Cuma, of Pithecusa, of Sparctacus, of Partenope, of Baja and so many others, which fills pages and pages of ancient history, would not exist.

Sometimes poetic ecstasy attacks the mind of the scientist; for quite the contrary to what the general public believe, science, rather than abolish poetic senti-

[7] *Jour. f. Prakt. Chem.*, 1886, p. 321; and Ber. d. D. Chem. Ges., vol. xxii., p. 447.

ment, further developes it, but in a more serious and refined form. If you will allow me I will describe to you one of my day dreams concerning the ground that we are now standing on, and which we will entitle the "Campania Felice without its Volcanoes."

When, as we wander around Naples, we reach the hill of Cuma and we encounter a few ruined walls and a few pot-sherds that peep out through the rich vegetation of that spot, where now the only inhabitants are the goats and the lizards, our imagination speeds back for nearly three millenniums when this same rock, almost in its present state, was chosen by the daring Greek navigators as the site of their new colonial town. All of us know the history of Cuma, all of us know that this little bit of Italy for the half of historic time held a very important place. We are deeply impressed when we make an effort to conceive clearly what three thousand years really is, how many generations lived and died during that time and in that place—but far, far greater are we impressed when we think that three thousand years is but a fraction in the *geological* history of that hill, and finally our mind fails to grasp the value of time when we consider that the physical record of this hill is not more than a minute fraction of the geological records of our globe.

Without going very far back in the geological history of our region I will ask you to follow me to the first part of the pliocene epoch, an epoch, as all know, considered quite near our own time. All of us now admire the beauty of the Gulf of Naples, which has few rivals in the entire world, but at that time its conformation was very different to what it is now. It then formed a very much larger gulf, represented to-day by the plain we call the *Campania Felice* with a large part of the Terra di Lavoro. We must figure to ourselves a broad gulf, limited on the north by the promontory of Gaeta, where its confines were limited by high limestone cliffs. Its coast had roughly the following trend: From Gaeta, it corresponded with the present provincial road to close under Castelforte and from there was almost represented by the valley of the Garigliano as far as the gorge between Mt. Faito and Mt. Cammino, by which narrow strait it was in communication with the sea covering the present plain of Cassino. Winding round the south of Mt. Cammino, it again extended northwards to Mignano. The eastern coast of this strait corresponded with the present line of railway from Mignano to Taverna S. Felice, which coast turning eastwards passed under Presenzano to extend into the mountains by the valley of the Volturno. From this point the coast, winding round several islands, represented to-day by hills and mountains separated from the main mass of the Appenines, extended into these latter, forming so many fiords. The sea then covered all the plain, and its waves beat the foot of the mountains behind Pietramelara, Pignataro Maggiore, Capua, Caserta, Nola, Palma, Sarno, Angri and Castellamare and then corresponded roughly with the present coast of the peninsula of Sorrento. In the middle of this great gulf rose two important isles—Capri and Mt. Massico, besides a quantity of smaller ones. Numerous fiords penetrated the Appenines where to-day we have the Garigliano, the Volturno, Valle di Maddaloni, Valle Candina, and the Valle di Avella. In fact this part of the coast of Italy in those pliocene times was very similar in configuration to that of the Istrian coast of to-day.

The rivers brought down to the sea sand and mud which, settling at the bottom of the gulf, prepared an almost flat sea bed, which later was to form the foundation of the Campanian plain. At that period the Campania Felice was only sea, and where to-day flourish vines, oranges, lemons and gardens of flowers then only grew marine algae.

The great fissure in the earth's crust which corresponds with the western coast of Italy, and along which were formed the Italian volcanoes, opened a way for the igneous magma to the bottom of this gulf. Numerous eruptive centres were formed, giving rise to the volcanoes of Tschia, Roccamonfina, Campi Phlegræi and Vesuvius. The order in which these different groups were formed is still an unsolved enigma. Tschia, as has been long known, shows by the fossiliferous deposits clothing its flanks to have undergone great elevation since its original formation, and as we have no such evidence in the other volcanoes, we must conclude for the greater antiquity of Tschia. I also believe that the volcanic group of Roccamonfina is very much older than that of the Phlegræan Fields and Vesuvius because we find the *piperno* and the *pipernoid tuff*, very old volcanic deposits in these regions, forming a mantle over Roccamonfina when it was almost a complete mountain. It must not be forgotten, however, that in the "Museum Breccia" first described by me we have evidence of the effusion in these regions of many varieties of rocks long anterior to the *piperno*.

Gradually the large quantity of lava and fragmentary materials that were ejected at the bottom of the gulf greatly diminished its depth, and this, combined with general elevation, resulted in the emergence of a number of volcanic islands at Roccamonfina, Tschia, Naples; and probably Vesuvius was at first, like the others, an island. Constant general elevation soon drove back the sea, leaving high and dry all that region we so well know. This plain with its volcanic hills and mountains constitutes one of the most beautiful, the most fertile and the healthiest regions of our earth if man were more capable of appreciating, enjoying and developing this *pezzo di cielo caduto in terra*.

So many are the advantages that our Vesuvius offers to the student of vulcanology that I think it advisable to pass them in review. This renowned volcano occupies a very central position in the civilized part of the globe, only a few kilometres from Naples, with all the resources of a great city, and in communication by numerous lines of passenger vessels and railways with all parts of Europe and America. Means of visiting Vesuvius are numerous, whilst the volcano is now entirely surrounded by a network of railways, besides good roads. By road and railway the top of the mountain can be reached, and upon its flanks can be found hotels and accommodation of all kinds, besides a meteorological observatory intended to be used for the daily study and record of its varying phases. The simple but interesting form of the mountain, the extraordinary and unrivalled variety of its productions, which surpass in number, beauty and interest those of any other volcano yet studied, are also a matter of maximum importance to the student. Besides this, of equal importance we must reckon that continuous activity with variation within such limits as to permit detailed study on the spot and still more fully in the university laboratories or elsewhere.

Besides, scattered over Italy and within a few hours' reach are several other active volcanoes, each having its own special interest, besides a large number of extinct ones and subsidiary volcanic phenomena, all of which beyond their scientific interest have a very great importance to the inhabitants from an agricultural, industrial and hygienic point of view. This is especially the case in the immediate vicinity of the active ones, so that it becomes the duty of the government to maintain a system of observation and record and to develop a school in which students may acquire a scientific knowledge of vulcanology.

At Naples we have a chair of terrestrial physics, but as under this name is included a vast amount of different

groups of phenomena it is impossible for its holder to give a fair share to vulcanology alone. So far the only chair of vulcanology was that of Catania, which was so well occupied by the late Professor O. Silvestri and which after his premature death was abolished.

These are, therefore, the reasons why we shall give a course of lectures on vulcanology in the University of Naples. My lectures will not be simply theoretical ones, for we shall make a number of excursions into the surrounding volcanic districts, where we can examine the phenomena and materials as they occur.

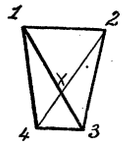
STEREOCHEMICAL THEORY.

BY T. PROCTOR HALL, PH.D., TABOR, IOWA.

IN the September number of the Journal of the Chemical Society Mr. S. U. Pickering points out that the fundamental idea of the tetrahedral arrangement of atoms about a carbon atom is that of the most symmetrical arrangement of four spheres about a fifth central sphere, and that the same principle leads to a triangular arrangement about triad nitrogen and a hexagonal arrangement about pentad nitrogen. In the case of the carbon atom this idea has proved so satisfactory that we are naturally anxious to see it tested in regard to all the other atoms. It is not, indeed, to be expected that the actual relations of atoms in three-fold space can be perfectly represented by any theory which takes account only of such relations as can be expressed in a two-fold diagram. Hence, stereochemistry will inevitably become more and more prominent as our knowledge of molecules increases. It may be worth while, therefore, to consider more fully than appears to have yet been done the arrangements which the application of the same fundamental idea require for other atoms having higher atomicities. In the following list the number of possible isomers of each kind is given. I have made no attempt to compare these with the facts; indeed that may not be possible as yet in many cases; but if the fundamental stereochemical idea is to be fairly tested, one of the first necessities is that the logical conclusions from it should be fairly and fully stated, and this I have tried to do.

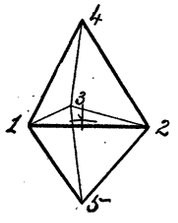
In the formulæ following M stands for the central atom, whose valance is given; A, B, C, etc., stand for monovalent elements or groups about M whose places in the diagram are indicated by the order of their positions in the formula. For example, MBA_2CB means that about M are grouped two atoms or groups of the kind A, taking the positions marked 2 and 3 in the diagram, two of the kind B in the positions 1 and 5, and one of the kind C in the position 4.

1. A Tetravalent atom may form the basis of two isomeric molecules, namely:



M^{iv} (2) { ABCD / ABDC.

2. Pentavalent atoms,—Hexahedron.



M^{v} (2) { AB_4 / B_4A.

M^{v} (4) { ABC_3 / AC_3B / C_3AB / BC_3A.

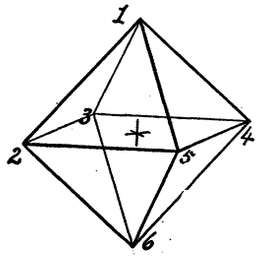
M^{v} (3) { A_2B_3 / AB_3A / B_3A_2.

M^{v} (6) { AB_2C_2 / AC_2B_2 / ABC_2B / ABCBC / B_2C_2A / C_2B_2A

M^{v} (10) { $ABCD_2$ / ABDCD / ABD_2C / ACDBD / ACD_2B / AD_2BC / BCDAD / BCD_2A / BD_2AC / CD_2AB.

M^{v} (20) { ABCDE / ABCED / ABDCE / ABDEC / ABECD / ABEDC / ACDBE / ACDEB / ACEBD / ACEDB / ADEBC / ADECB / BCDAE / BCDEA / BCEAD / BCEDA / BDEAC / BDECA / CDEAB / CDEBA.

3. Hexavalent atoms,—Oktahedron.



M^{vi} (2) { A_2B_4 / AB_4A.

M^{vi} (2) { A_3B_3 / A_2B_3A.

M^{vi} (2) { ABC_4 / AC_4B

M^{vi} (3) { AB_2C_3 / ABC_3B / $ABCDC_2$.

M^{vi} (6) { $A_2B_2C_2$ / A_2BCBC / A_2BC_2B / A_2CBCB / AB_2C_2A / ABCBCA.

M^{v} (5) { $ABCD_3$ / ABD_2CD / $ABDCD_2$ / ABD_3C / ACD_3B.

M^{vi} (30) { ABCDEF / ABEDCF / ABCEDF / ABDECF / ABDCEF / ABECDF / and similarly / A———E (six forms) / A———D " / A———C " / A———B "

M^{vi} (8) { ABC_2D_2 / $ABCD_2C$ / ABCDCD / ABD_2C_2 / $ABDC_2D$ / ABDCDC / AC_2D_2B / ACDCDB

M^{vi} (15) { $ABCDE_2$ / ABEDCE / $ABDCE_2$ / ABECDE / ABCEDE / ABDECE / $ABCE_2D$ / ABE_2CD / ABECED / $ABDE_2C$ / ABE_2DC / ABEDEC / $ACDE_2B$ / ACE_2DB / ACEDEB

4. Heptavalent atoms,—Irregular.

The nearest possible approach to a regular arrangement of seven atoms around one is perhaps that indicated in Figure 4, in which one atom is above M, three others are at the corners of a horizontal triangle and the